CLAIMS:

1. A structural component in a hot gas path assembly, said structural component comprising a nanocomposite, wherein said nanocomposite comprises:

a) a metallic matrix; and

b) a plurality of nanoparticles dispersed throughout said metallic matrix, wherein said plurality of nanoparticles comprises from about 4 volume percent to about 30 volume percent of said nanocomposite.

2. The structural component according to Claim 1, wherein said metallic matrix comprises at least one of a nickel-based alloy, an iron-based alloy, and combinations thereof.

3. The structural component according to Claim 2, wherein said nickel-based alloy is one of a Ni-Cr based alloy, a Ni-Cr-Al based alloy, and combinations thereof.

4. The structural component according to Claim 2, wherein said iron-based alloy is one of a Fe-Cr based alloy, a Fe-Cr-Al based alloy, and combinations thereof.

5. The structural component according to Claim 2, wherein said hot gas path assembly is a turbine assembly.

6. The structural component according to Claim 5, wherein said structural component is one of a combustor, a vane, a wheel, a disc, and a casing.

7. The structural component according to Claim 1, wherein each of said plurality of nanoparticles comprises at least one of an inorganic oxide, an inorganic carbide, an inorganic nitride, an inorganic boride, an inorganic oxycarbide, an inorganic oxynitride, an inorganic silicide, an inorganic aluminide, and combinations thereof.

8. The structural component according to Claim 7, wherein said inorganic oxide is one of yttria, alumina, zirconia, hafnia, and combinations thereof.

9. The structural component according to Claim 7, wherein said inorganic carbide is a carbide of at least one of hafnium, tantalum, molybdenum, zirconium, niobium, chromium, titanium, tungsten, and combinations thereof.

10. The structural component according to Claim 1, wherein each of said plurality of nanoparticles has at least one dimension, wherein said alt least one dimension that is in a range from about 10 nm to about 500 nm.

11. The structural component according to Claim 10, wherein said dimension that is in a range from about 10 nm to about 30 nm.

12. The structural component according to Claim 1, wherein said plurality of said nanoparticles comprise from about 10 volume percent to about 30 volume percent of said nanocomposite.

13. The structural component according to Claim 1, wherein said nanocomposite thermally stable up to about 1200°C.

14. A nanocomposite, said nanocomposite comprising:

a) a metallic matrix; and

b) a plurality of nanoparticles dispersed throughout said metallic matrix, wherein said plurality of nanoparticles comprises from about 4 volume percent to about 30 volume percent of said nanocomposite, and wherein said nanocomposite is formed by providing a nanocomposite powder, consolidating said nanocomposite powder to form a green body, and thermomechanically processing said green body to form said nanocomposite.

15. The nanocomposite according to Claim 14, wherein said metallic matrix comprises at least one of a nickel-based alloy, an iron-based alloy, and combinations thereof.

16. The nanocomposite according to Claim 15, wherein said nickel-based alloy is one of a Ni-Cr based alloy, a Ni-Cr-Al based alloy, and combinations thereof.

17. The nanocomposite according to Claim 15, wherein said iron-based alloy is one of a Fe-Cr based alloy, a Fe-Cr-Al based alloy, and combinations thereof.

18. The nanocomposite according to Claim 14, wherein each of said plurality of nanoparticles comprises at least one of an inorganic oxide, an inorganic carbide, an inorganic nitride, an inorganic boride, an inorganic oxycarbide, an inorganic oxynitride, an inorganic silicide, an inorganic aluminide, and combinations thereof.

19. The nanocomposite according to Claim 18, wherein said inorganic oxide is one of yttria, alumina, zirconia, hafnia, and combinations thereof.

20. The nanocomposite according to Claim 18, wherein said inorganic carbide is a carbide of at least one of hafnium, tantalum, molybdenum, zirconium, niobium, chromium, titanium, tungsten, and combinations thereof.

21. The nanocomposite according to Claim 14, wherein each of said plurality of nanoparticles has at least one dimension, wherein said alt least one dimension is a range from about 10 nm to about 500 nm.

22. The nanocomposite according to Claim 21, wherein said dimension is in a range from about 10 nm to about 30 nm.

23. The nanocomposite according to Claim 14, wherein said plurality of said nanoparticles comprise from about 10 volume percent to about 30 volume percent of said nanocomposite.

24. The nanocomposite according to Claim 14, wherein said thermomechanical process is a cryogenic milling process.

25. The nanocomposite according to Claim 24, wherein said cryogenic milling process is one of a non-reactive milling process and a reactive cryogenic milling process.

26. The nanocomposite according to Claim 14, wherein said thermomechanical process comprises at least one of extrusion, forging, rolling, and swaging of said nanocomposite.

27. The nanocomposite according to Claim 14, wherein said severe plastic deformation comprises equiaxial channel angular processing of said nanocomposite.

28. The nanocomposite according to Claim 14, wherein said severe plastic deformation comprises at least one of torsion extrusion and twist extrusion of said nanocomposite.

29. A structural component in a hot gas path assembly comprising a nanocomposite, wherein said nanocomposite comprises:

a) a metallic matrix, wherein said metallic matrix comprises at least one of a nickel-based alloy, an iron-based alloy, and combinations thereof; and

b) a plurality of nanoparticles dispersed throughout said metallic matrix, wherein said plurality of nanoparticles comprises from about 4 volume percent to about 30 volume percent of said nanocomposite, and wherein said nanocomposite is formed by a thermomechanical process followed by severe plastic deformation.

30. The structural component according to Claim 29, wherein said nickel-based alloy is one of a Ni-Cr based alloy, a Ni-Cr-Al based alloy, and combinations thereof.

31. The structural component according to Claim 29, wherein said iron-based alloy is one of a Fe-Cr based alloy, a Fe-Cr-Al bases alloy, and combinations thereof.

32. The structural component according to Claim 29, wherein said hot gas path assembly is a turbine assembly.

33. The structural component according to Claim 32, wherein said structural component is one of a combustor, a vane, a wheel, a disc, and a casing.

34. The structural component according to Claim 29, wherein each of said plurality of nanoparticles comprises at least one of an inorganic oxide, an inorganic carbide, an inorganic nitride, an inorganic boride, an inorganic oxycarbide, an inorganic oxynitride, an inorganic silicide, an inorganic aluminide, and combinations thereof.

35. The structural component according to Claim 34, wherein said inorganic oxide is one of yttria, alumina, zirconia, hafnia, and combinations thereof.

36. The structural component according to Claim 35, wherein said inorganic carbide is a carbide of at least one of hafnium, tantalum, molybdenum, zirconium, niobium, chromium, titanium, tungsten, and combinations thereof.

37. The structural component according to Claim 29, wherein each of said plurality of nanoparticles has at least one dimension, wherein said alt least one dimension is a range from about 10 nm to about 500 nm.

38. The structural component according to Claim 37, wherein said dimension is in a range from about 10 nm to about 30 nm.

39. The structural component according to Claim 29, wherein each of said plurality of nanoparticles is substantially spherical.

40. The structural component according to Claim 29, wherein each of said plurality of nanoparticles has a substantially ellipsoidal shape.

41. The structural component according to Claim 29, wherein said plurality of said nanoparticles comprise from about 10 volume percent to about 30 volume percent of said nanocomposite.

42. The structural component according to Claim 29, wherein said nanocomposite thermally stable up to about 1200°C.

43. The structural component according to Claim 29, wherein said thermomechanical process is a cryogenic milling process.

44. The structural component according to Claim 29, wherein said cryogenic milling process is one of a non-reactive milling process and a reactive cryogenic milling process.

45. The structural component according to Claim 29, wherein said thermomechanical process comprises at least one of extrusion, forging, rolling, and swaging of said nanocomposite.

46. The structural component according to Claim 29, wherein said severe plastic deformation comprises equiaxial channel angular processing of said nanocomposite.

47. The structural component according to Claim 29, wherein said severe plastic deformation comprises at least one of torsion extrusion and twist extrusion of said nanocomposite.

48. A method of making a bulk nanocomposite, wherein the nanocomposite comprises a metallic matrix and a plurality of nanoparticles dispersed throughout the metallic matrix, wherein the metallic matrix comprises at least one of a nickel-based alloy, an iron-based alloy, and combinations thereof, and wherein the plurality of nanoparticles comprises from about 4 volume percent to about 30 volume percent of the nanocomposite, the method comprising the steps of:

a) providing a nanocomposite powder, wherein the nanocomposite powder comprises a plurality of nanoparticles and a metallic matrix material;

b) consolidating the nanocomposite powder; and

c) thermomechanically processing the nanocomposite powder to form the bulk nanocomposite.

49. The method according to Claim 48, wherein the step of providing the nanocomposite powder comprises forming the plurality of nanoparticles by at least one of mechanofusion, mechanical alloying, cryomilling, and combinations thereof.

50. The method according to Claim 49, wherein the step of forming the plurality of nanoparticles comprises cryomilling the metallic matrix material to form the plurality of nanoparticles.

51. The method according to Claim 50, wherein the step of cryomilling said metallic matrix material comprises cryomilling said metallic matrix material in a reactive atmosphere.

52. The method according to Claim 51, wherein the reactive atmosphere comprises at least one of nitrogen and a hydrocarbon.

53. The method according to Claim 48, wherein the step of consolidating the nanocomposite powder comprises pressing the nanocomposite powder to form a compact.

54. The method according to Claim 48, wherein the step of thermomechanically processing the nanocomposite powder comprises at least one of forging, hot-extruding, and hot-rolling, the nanocomposite powder.

55. The method according to Claim 48, wherein the step of thermomechanically processing the nanocomposite powder comprises subjecting the nanocomposite powder compact to severe plastic deformation.

56. The method according to Claim 55, wherein the step of subjecting the nanocomposite powder compact to severe plastic deformation comprises at least one of one of equiaxial channel angular processing of the nanocomposite powder, torsion extruding the nanocomposite powder, and twist extruding the nanocomposite powder.